Problem set 7

- The Center of Mass

Duffy has a 21.0 cm long toy stick. The stick has linear density (mass per length) given by $\lambda = 50.0 + 20.0x$, where x is the distance from one end, measure in meters, and λ is the grams/meter.

a) What is the mass of the rod?
b) How far from the $x = 0$ end is its center of mass?

- Angular Velocity and Acceleration

A fan blade rotates with angular velocity given by $\Omega_z(t) = \gamma - \beta t^2$, where $\gamma = 5.00\, rad/s$ and $\beta = 0.800\, rad/s^3$.

a) Calculate the angular acceleration as a function of time.

b) Calculate the instantaneous angular acceleration α_z at $t = 3.00\, s$ and the average angular acceleration α_{av-z} for the time interval $t = 0$ to $t = 3.00\, s$. How do these two quantities compare? If they are different, why?

- Energy in Rotational Motion

A wagon wheel is constructed as shown in Fig. 7.1. The radius of the wheel is 0.300 m, and the rim has mass 1.40 kg. Each of the eight spokes that lie along a diameter and are 0.300 m long has mass 0.280 kg. What is the moment of inertia of the wheel about an axis through its center and perpendicular to the plane of the wheel?

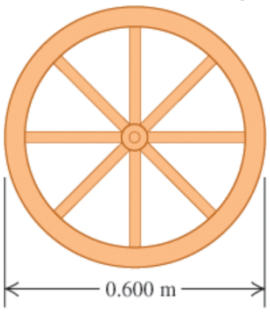

Figure 7.1

- Relating Linear and Angular Kinematics

An electric turntable 0.750 m in diameter is rotating about a fixed axis with an initial angular velocity of 0.250 rev/s and a constant angular acceleration of 0.900 rev/s^2.

a) Compute the angular velocity of the turntable after 0.200 s.
b) Through how many revolutions has the turntable spun in this time interval?
c) What is the tangential speed of a point on the rim of the turntable at t = 0.200 s?
d) What is the magnitude of the resultant acceleration of a point on the rim at t = 0.200 s?

- Rotational Kinetic Energy

A uniform, solid disk with mass m and radius R is pivoted about a horizontal axis through its center. A small object of the same mass m is glued to the rim of the disk. If the disk is released from rest with the small object at the end of a horizontal radius, find the angular speed when the small object is directly below the axis.